



UNITED STATES  
**NUCLEAR REGULATORY COMMISSION**  
ADVISORY COMMITTEE ON NUCLEAR WASTE  
WASHINGTON, DC 20555 - 0001

ACNWR-0243

June 9, 2006

The Honorable Nils J. Diaz  
Chairman  
U.S. Nuclear Regulatory Commission  
Washington, DC 20555-0001

SUBJECT: FUTURE VOLCANISM AT YUCCA MOUNTAIN - COMMENTS ON THE NRC  
STAFF MODEL FOR THE FLUVIAL REDISTRIBUTION OF VOLCANIC  
TEPHRA

Dear Chairman Diaz:

During its 168<sup>th</sup> and 169<sup>th</sup> meetings, the Advisory Committee on Nuclear Waste (the Committee) was briefed on modeling of processes related to the potential risk from igneous activity at the proposed Yucca Mountain repository. An accompanying letter addresses the igneous intrusive release scenario, including the hypothetical interaction of the intruding magma with the repository and waste packages.

This letter reports the Committee's observations and recommendations on the briefing during the 168<sup>th</sup> meeting by NRC staff from the Office of Nuclear Material Safety and Safeguards (NMSS) on the status of modeling the fluvial (water-driven) redistribution of tephra from a potential igneous event at the proposed Yucca Mountain repository. The staff briefing was based on a recent (July 2005) report prepared by the Center for Nuclear Waste Regulatory Analyses (CNWRA) (Hooper, 2005). The Committee finds the direction of the fluvial redistribution modeling generally acceptable, but recommends improvements that should decrease the uncertainty in the modeling results, including adding important processes that are not included in the current model (e.g., effect of major floods).

The July 2005 report contains the conceptual basis of the model, its input parameters, and results from a hypothetical scenario in which an extrusive igneous event intersects a repository at Yucca Mountain leading to deposition of radionuclide-bearing tephra (ash) in the Fortymile Wash catchment basin east of Yucca Mountain. In the CNWRA model the tephra is eroded from the catchment area by long-term fluvial action (overland runoff and stream erosion) and deposited in the vicinity of the Reasonably Maximally Exposed Individual (RMEI). The ash is assumed to be resuspended in the vicinity of the RMEI by surface winds, thus resulting in a long-term inhalation dose to the nearby receptor, in addition to the dose contribution to the nearby RMEI resulting from original tephra deposited in the area. The model is restricted to Fortymile Wash because only fluvially remobilized tephra from this drainage leads to deposition in the vicinity of the RMEI.

Observations Regarding the July 2005 CNWRA Report:

1. The Committee understands that modeling of tephra redistribution in the vicinity of Yucca Mountain is incomplete at this time. Nonetheless the Committee believes that the sediment mass balance methodology used in the model is based on sound principles

and is capable of estimating the deposition of the remobilized ash in the vicinity of the RMEI. Redistribution of tephra is the summation of all natural surface processes, both fluvial and wind (eolian). These processes are potentially important to tephra redistribution in the vicinity of Yucca Mountain because of the arid climate and limited surface vegetation that can protect the surface materials from erosion. Accordingly, these two surface processes and their results need to be integrated in the modeling.

2. Model assumptions and input parameters are uncertain, and the results based on them are potentially inaccurate, because sediment transport and hydrologic data from the Yucca Mountain region and Fortymile Wash are limited. In addition, some potentially important processes have not been included in the model. Questions regarding assumptions and parameter uncertainties and processes include:
  - The recurrence interval of floods that affect ash redistribution is based on a limited record over a 30-year period ending in 1999. Examining a longer period could reduce uncertainty.
  - Wind erosion is likely to be a significant process for removing ash from the catchment region of Fortymile Wash. The staff needs to consider its effect in mass balance modeling.
- C The maximum mass of the tephra particles that can be moved by fluvial action from the catchment area, and the effect of weathering and erosion that may decrease tephra size so that it can be remobilized by fluvial processes, are not taken into account.
- C The estimated volume of the active depositional fan of Fortymile Wash that would actively contribute to the RMEI source term is inadequately documented and apparently does not consider all drilling information on the thickness of the fan.
3. The fluvial redistribution model does not account for the preferential removal of the smaller-sized fraction of the tephra (< 10 microns) from both the catchment and depositional areas. This fraction could contribute significantly to inhalation dose. Additionally, the model assumes that no sediments are transported beyond the 10-km long active fan. This assumption appears to neglect the effects of large floods in Fortymile Wash that have transported sediments as far as the Amargosa River and beyond.
4. The Committee recognizes that the NRC staff has not yet performed sensitivity studies to determine the fluvial redistribution model parameters and assumptions most important to risk to the RMEI. The Committee plans to review the results of these studies at a future briefing.

#### Recommendations:

1. The Committee considers the sediment mass balance method to be conceptually appropriate for modeling the redistribution of radionuclide-bearing tephra to the vicinity of the RMEI, but recommends that the NRC staff consider the effects of both wind and fluvial erosion and redistribution in order to be realistic and effective.

2. The fluvial redistribution modeling should evaluate the effects of large flood events that could carry suspended sediments beyond the active fan and erode previously deposited sediments on the active fan.
3. The NRC staff should review and document its basis for selecting the modeling parameters, assumptions, and processes, such as those presented in observation 2.

The Committee looks forward to further interaction with the NRC staff upon completion of the model addressing the redistribution of tephra by both fluvial and wind processes and the application of this model to estimating risk to the RMEI.

Sincerely

**/RA/**

Michael T. Ryan  
Chairman

Reference:

Hooper, D. M., Modeling the Long-Term Fluvial Redistribution of Tephra in Fortymile Wash, Yucca Mountain, Nevada, CNWRA report, NRC Accession No. ML0529103341, July, 2005.

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